The graph shows the answers of first-year students to the blitz survey, which shows the attitude of the participants of the group, his idea of the future, as the realization of their needs. The graph highlighted in green columns is an expectation of the student's future; he wants to get in the learning process at the university. Red bars indicate that the students do not focus on these criteria.

Closing

Primary blitz survey provides a comprehensive picture of the incoming contingent, which in turn allows the institution to coordinate plans for the educational process before the academic year starts.

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EXCITATION MODEL OF CARDIAC P CELLS OF THE CARDIAC CONDUCTION SYSTEM

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Abstract. The article considers elaboration of the mathematical model of cardiac electrical activity which will allow investigating excitation propagation processes at all sites of the cardiac conduction system. The proposed model is generated on the basis of parametric elements of an electric circuit with distributed parameters and approximation of time dependencies of conduction in ion channels by cubic splines.

Keywords: neurons, electrocardiography, cardiology, numerical methods, diagnosis, cardiovascular diseases (CVD), physiology, action potential, membrane potential.

1. The cardiac conduction system. There is a specific, anatomically separated master system in a human and animal heart. It comprises the sinoatrial and atrioventricular nodes, internodal atrial filaments, His bundle with left and right bands and Purkinje fibers. This system is formed by specific muscle cells which possess automatism properties and high (compared to non-specific muscle cells of atria and ventricles) excitation speed. A pulse is generated in P cells of the SA node (first-order pacemaker) which naturally sets the heart rhythm.

Then excitation is propagated to atrial surfaces resulting in their depolarization, following which it goes through internodal pathways to the AV node (second-order pacemaker) and excites (depolarizes) it. Afterwards the pulse is transferred along the His bundle and propagated to the right and left while exciting ventricular muscles [1].

Propagation of an electric pulse (action potential) in the conduction system as well as atrial and ventricular muscles is accompanied by depolarization and repolarization of corresponding cardiac cells. These processes are similar to action potential conduction in nerve cell processes [2] and primarily conditioned by conductance change of sodium, calcium and potassium ion channels in cell membranes under action of supraliminal stimulations.

2. Results of modelling. The equivalent electric diagram for the unit length of a cell membrane site in the cardiac conduction system can be expressed as five parallel branches. Three branches correspond to sodium, calcium and potassium ion channels. Electromotive forces (EMF) in these branches are determined by previous concentrations of corresponding ions inside and outside the cell, and their conductances GK, GCa and GNa are complex functions of the membrane potential and time [3]. These functions are different for various conduction system sites due to features of ion channels.

Based on the elaborated mathematical model, the digital model whereon mathematical experiments have been performed is implemented. Cell membrane potentials are selected as initial conditions for voltages.

To excite the cardiac conduction system, voltage of cardiac P cells is modeled with square-wave pulses, amplitudes of which are supraliminal values, and their frequency corresponds to heart rate. Individual results of mathematical experiments are shown on fig. 1.

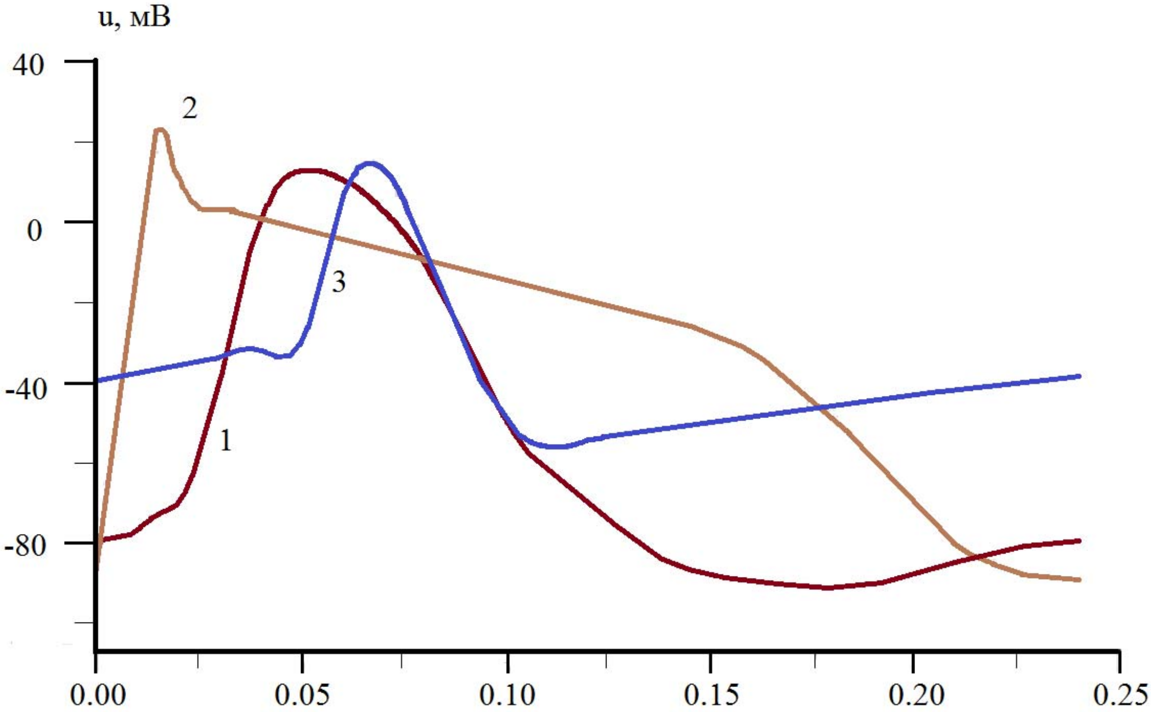

Fig. 1. Action potential curves for different sites of the cardiac conduction system: 1 – AV node site; 2 – His bundle site; 3 – site with P cells

Conclusions

The elaborated mathematical model allows investigating excitation propagation in a human heart and may be the element for generation of complex two-dimensional models as well as three-dimensional models in perspective. Electrophysiological processes in the cardiac conduction system are of prime importance for cardiologists. The pathological sites in the proposed model can be modeled by change of membrane properties (e.g. ion conductances). The mathematical model of cardiac electrical activity described in this article can be applied as the basis for its further use in mathematical models of electrocardiography.

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